

***STRONGYLOPHTHALMYIA PENGELLYI* N. SP., A SECOND  
SPECIES OF NEARCTIC STRONGYLOPHTHALMYIIDAE  
(DIPTERA)**

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**Abstract**

*J. ent. Soc. Ont.* 137: 81–109

*Strongylophthalmyia pengellyi* new species is described from Canada (New Brunswick, Ontario, Québec) and the United States (Michigan, Utah). A key is provided to distinguish it from the only other Nearctic species, *S. angustipennis* Melander. The species shows unusual sexual dimorphism of the legs and of the wing. Copulatory posture suggests function for some of these modifications. Adult *S. pengellyi* were sampled with sticky traps, Malaise traps, and by searching tree trunks. An association with decrepit trembling aspen is presumed based on occurrence of adults of both species on tree trunks and the larvae of *S. angustipennis* under the bark. Beetles and fungi may play a role in the life history of these flies. *Strongylophthalmyia pengellyi* has a flight period from late May to late July with a peak in early to mid-June; *S. angustipennis* begins flying in early June but continues until September. Comparison of captures using coloured sticky traps suggests superiority of colourless translucent boards.

*Published July 2007*

**Introduction**

Strongylophthalmyiidae is a relatively small family of slender, long-legged flies divided into two genera—the monotypic Southeast Asian genus *Nartshukia* Shatalkin, 1993 and the type genus *Strongylophthalmyia* Heller, 1902. Shatalkin (1996) incorrectly refers to a third genus, *Longinasus* Frey, 1956 which was recognized as a junior subjective synonym of the richardiid genus *Ozaenina* Enderlein, 1912 by Steyskal (1968).

*Strongylophthalmyia* currently includes 45 species with the majority (38) occurring in the Oriental and Australasian Regions, two of these ranging as far north as Japan. Although there are no formal records of described species in Australia, Evenhuis (1989) refers to unpublished records and undescribed Australian species. There are six Palaearctic species and one previously described Nearctic species, *S. angustipennis* Melander. No species of Strongylophthalmyiidae are known from the Neotropical or Afrotropical regions (two African species previously treated as *Strongylophthalmyia* were transferred to the Clusiidae by Barraclough 2000).

The most comprehensive keys are provided by Frey (1956—world species), Steyskal (1971—world species), Shatalkin (1993—Palearctic species; 1996—*crinita*- and *punctata*-groups), and Iwasa (1992—Japanese species). The distinction between *Nartshukia* and *Strongylophthalmyia* rests primarily with the position of the ocellar tubercle, which is characteristically displaced anteriorly in *Strongylophthalmyia* (see Shatalkin 1993 for a short discussion of the affinities of *Nartshukia*). This suggests that the one species of *Nartshukia* is the sister species to a monophyletic *Strongylophthalmyia*.

For some time, the genus *Strongylophthalmyia* was classified with the Psilidae (as late as Shewell 1965). Hennig (1940) described four species, treating them as Psilidae but later suggested that this genus might be better treated as a separate family associated with the Tanypezidae (Hennig 1958). The Strongylophthalmyiidae is now widely recognized as the sister taxon to the Tanypezidae based on several synapomorphies (e.g. hypandrium with internal arch-shaped sclerites, internal sclerite within 8<sup>th</sup> female abdominal segment with loop-like [spatulate] anterior end (Roháček 1998), and possibly the biramous anterior spiracle of the larva). Some authors (e.g. Griffiths 1972; McAlpine 1997) argue for combining these two closely related groups into a single family, but separate family status for the Strongylophthalmyiidae is retained here following the position taken by many others (Steyskal 1987a, b; McAlpine 1989; Yang and Wang 1992; Shatalkin 1996; Iwasa 1998; Roháček 1998; Papp et al. 2006; but see Roháček 1998 and McAlpine 1997 for further discussion).

Biological and life-history data for these small flies are particularly lacking in North America. Steyskal (1987b) reports on adult specimens of *S. angustipennis* emerging from “felled trees” from Laniel, Québec (tree species unknown, CNCI—see codens below). European records are primarily those of Krivosheina (1981; 1984) who reports on rearing larvae of *S. ustulata* (Zetterstedt) and *S. pictipes* Frey from under bark of rotting logs of aspen, and of *S. stackelbergi* Krivosheina from under the bark of elm and birch. The larvae are described as common on wet bast [inner bark or phloem] and pupation occurs in the upper layers of bast under the dead bark. Shatalkin (1993) summarizes field observations made on the behaviour of adults of *S. ustulata*, *S. crinita* Hennig, *S. raricornis* Shatalkin, and *S. pictipes*. Additional unpublished records from New Guinea mention adult behaviour mimicking ants with which they were collected on banana leaves while others were collected from leaves of *Alocasia* in Australia (Evenhuis 1989).

### **History of discovery**

Despite its wide distribution, there is a particular Ontario flavour to the discovery of a new species of Nearctic *Strongylophthalmyia*. The following section recognizes the contributions of others, emphasizes that “new” species can be quite “old”, and that serendipity can play a role in the description of our native fauna.

Around 1979, J. F. McAlpine (CNCI) showed me representatives of *Strongylophthalmyia* during a visit as a student. These included three female specimens (Aspen Grove, Utah, 1975) collected during a study of scolytids (Petty 1977; BYUC) attacking trembling aspen, *Populus tremuloides* Michaux. In 1975, McAlpine determined these to be a new species near *S. pictipes*.

A male and a female from southwestern Québec (La Ferme, Adrien Robert, 1943) were determined by G. E. Shewell (CNCI) in 1946 as a new species of *Strongylophthalmyia*.

McAlpine had not mentioned anything about the modifications of the male wing and mid basitarsus because he had not seen a male. These two specimens only came to light during this study, presumably after being moved to the same drawer as the Utah specimens (most likely after his retirement in 1985 or Shewell's death in 1996).

Recently, a single female specimen was found with other *S. angustipennis* in the CNCI holdings of unidentified Psilidae (M. Buck, DEBU). It had been collected in New Brunswick (Kouchibouguac National Park) by J. F. McAlpine in 1977! This specimen must have been forgotten by McAlpine as it was collected two years after his identification of the Utah specimens.

In 2002, a research team led by S. B. Holmes (GLFC) began investigating the effects of forest harvesting practices on birds south of White River, Ontario (see Mosley et al. 2006 for summary of relevant data from 2003). While providing assistance in identification of insects that might serve as food for birds, I recognized a substantial number of *Strongylophthalmyia*. They clearly represented two species, one being the same as represented by the specimens housed at CNCI.

Subsequent to this, I installed additional sticky traps (2003) on one of the research blocks south of White River. This effort and active searching for flies, narrowed the focus to dead or dying trembling aspen here and elsewhere (label data from the Utah specimens at CNCI had not yet been consulted). Additional sampling was then carried out elsewhere in 2004 and 2005. The results from these efforts are the subject of this paper which provides a formal description of this "new" species of *Strongylophthalmyia* along with field observations and capture data from sticky traps during the period 2002–2005.

## Materials and Methods

**Specimen depositories** (Evenhuis and Samuelson 2006). The examined material is deposited at the following institutions: AMNH—American Museum of Natural History, New York, New York (D. A. Grimaldi, T. C. Nguyen); BYU—M. L. Bean Collection, Brigham Young University, Provo, Utah (R. Baumann, S. Clark); CNCI—Canadian National Collection of Insects, Agriculture and Agri-Food Canada, Ottawa, Ontario (J. M. Cumming); DEBU—University of Guelph Insect Collection, Department of Environmental Biology, University of Guelph, Guelph, Ontario (S. A. Marshall, M. Buck); EMUS—Entomological Museum, Department of Biology, Utah State University, Logan, Utah (W. Hanson); GLFC—Great Lakes Forestry Centre, Entomological Collection, Sault Ste. Marie, Ontario (K. Nystrom); LACM—Natural History Museum of Los Angeles County, Los Angeles, California (B. V. Brown); ROME—Royal Ontario Museum, Toronto, Ontario (D. Currie, B. Hubley); UBCZ—The Spencer Entomological Museum, University of British Columbia, Vancouver, British Columbia (G. Scudder, K. M. Needham); USNM—National Museum of Natural History, Smithsonian Institution, Department of Entomology, Washington, DC (A. L. Norrbom, F. C. Thompson).

**Specimen preparation and morphology.** Flies were removed from sticky boards after loosening with Histoclear II (National Diagnostics, Atlanta, GA), soaked overnight, heated in fresh Histoclear II, transferred to two washes of hot 95% ethanol, and then critical point



dried. Abdomens and genitalia were cleared in hot 10% NaOH solution, neutralized with glacial acetic acid, and examined in glycerin. Electron micrographs were obtained using a Hitachi 570 scanning electron microscope. Morphological terms are primarily those used by McAlpine (1981). Abbreviations: S—sternite, T—tergite, TS—syntergosternite.

**Collecting methods.** Traps with large translucent sticky boards (two boards of 26 cm x 26 cm slotted and oriented vertically in an “X”; Coroplast™, Coroplast Inc., Granby, QC) on poles at about 3 m above ground were used in White River, Ontario in 2002 and 2003. The study site and traps are described by Mosley et al. (2006) and the traps were deployed at different intensities of sampling (90 traps in 2002, 36 traps in 2003). Coloured mini sticky boards (14.2 cm x 12.5 cm) of four different “colours” (1 colourless and translucent, and 3 opaque colours of light blue, white, light yellow) were deployed in 2003 (Block 6, upland Sites 1, 3, 4, 9; see Mosley et al. 2006). The coloured boards were mounted individually in two linear series beginning at two maximum heights of about 3 m (high) and 1.5 m (low). The 24 traps (6 poles on each of 4 sites) represented all permutations of four colours (replicated on each pole, high and low). Tangle-Trap® (brushable formula, The Tanglefoot Co., Grand Rapids, MI) was applied in a thin film leaving a non-sticky narrow border on one short side as a handling surface. Trapping ran from 29 May to 23 July with four consecutive trapping periods of two weeks each (second trapping period included flies removed in the field after four days). Additional trapping was conducted to compare only colourless translucent and light blue mini boards at the lower height (1.5 m, n=6), paired and parallel to each other (25 June to 9 July). All mini boards were transported in rigid plastic compact disc trays (Model TCD30, Case Logic Canada Inc., Toronto, ON).

Mini sticky traps were subsequently used in seven other localities in attempts to record additional geographic locations for *S. pengellyi* new species. These consisted of four colourless translucent mini boards at the lower height (1.5 m) (note: specimens labeled “multi-colour” sticky trap originate from the 2003 study; all other specimens labeled as “opaque”, “opaque mini”, or “transluc.[ent][sic] mini” sticky trap were captured on colourless translucent large or mini boards). Six short (1.5 m) poles were set out in each of six aspen stands in early to mid June 2004 (Cochrane–32 days, Hearst–31, Mattawa–20, McKerrow–20, Pancake Bay–21, Shabaqua Corners–35) and in one stand in late May in 2005 (Sault Ste. Marie–96).

Malaise traps fitted with ethanol collection heads were erected on or near the plots in the White River research area (Block 6) in 2003. Live adults were collected into 70% ethanol. Others were transported to the laboratory in screened tubes for further observation in either a flight cage supplied with an aspen branch or in Petri plates.

Immature stages were obtained from a decrepit standing trembling aspen (Dubreuilville: no leaves and only main branches remaining, bark in lower stem still photosynthetic). The tree was felled and strips of bark and inner bark (bast) were removed on 20 May and 2 June 2005 from an original height of about 8–10 m and transported in pails to the laboratory. Previously, in 2003, a small sample of aspen branches from a broken crown from this site had been held in the laboratory and yielded adult scolytid beetles but no strongylophthalmyiid flies.



**Field sites.** Significant observations or collections were made at three other sites besides the main study site at White River (Mosley et al. 2006): 1–Dubreuilville, Ontario (~35 km WSW, several visits, 2003–2005) was a short distance off the side of the highway and the source of immatures of *Strongylophthalmyia*; 2–Thessalon, Ontario (~95 km NNE, 18 June 2004) was also a roadside site of dense regrowth of trembling aspen where an aggregation of *S. pengellyi* was observed; 3–Sault Ste. Marie, Ontario (Baseline Rd., 21 May–25 August 2005) was an old disturbed, regrowth stand of mostly aspen and a modest source of both species of *Strongylophthalmyia* on sticky traps near recently blown down aspens.

**Statistical analysis.** The influence of colour and height on fly captures of the mini sticky boards in 2003 (SigmaStat, Windows Version 3.10.0, Systat Software Inc., Richmond, CA) was tested on accumulated seasonal counts for each board (pole-height-colour combination). Normality and homogeneity of variances for two-way ANOVA could not be achieved after transformation so nonparametric techniques were used. Count data for the four boards of each height on each pole (n=24) were combined for tests of the effect of height. Data for the two boards of each colour on each pole (n=24) were combined to test for effects of colour. Nonparametric Kruskal-Wallis tests were conducted on the seasonal catches of males, females, and both genders combined. Significant Kruskal-Wallis tests ( $\alpha=0.05$ ) were followed by Student-Newman-Keuls multiple comparisons to recognize any possible pairwise differences.

## Results and Discussion

### *Strongylophthalmyia* Heller, 1902

*Strongylophthalmyia* Heller, 1902: 226, (new name for *Strongylophthalmus* Hendel, 1902).

Type species: *Chyliza ustulata* Zetterstedt, 1847: 2427. Frey, 1956: 129 (key, world); Steyskal, 1971: 142 (key, world); Shatalkin, 1993: 124 (1994: 155, key, Palaearctic), 1996: 151 (key, *crinita*-group); Iwasa 1992: 660 (key, Japan).

*Strongylophthalmus* Hendel, 1902: 179. Type species: *Chyliza ustulata* Zetterstedt, 1847: 2427, original designation. Preoccupied by *Strongylophthalmus* Motschulsky, 1860: pl. X.

*Labropsila* de Meijere, 1914: 241. Type species: *Labropsila polita* de Meijere, 1914: 242, designated by Hennig, 1941: 36.

**Generic diagnosis.** The Nearctic species are small, slender, long-legged, blackish flies with paler areas on head, thorax and legs. The wing is mostly hyaline, usually with a faint apical cloud. The ocelli are displaced forward, the vibrissa absent, and the thorax elongate.

### Key to the Nearctic species of *Strongylophthalmyia*

1. Frons extensively yellow anteriorly. Two notopleural setae present and no additional setulae. Setae of head and thorax mostly pale. Femora mostly yellow, at most with preapical black band on hind femur and brown band on mid femur. Wing without

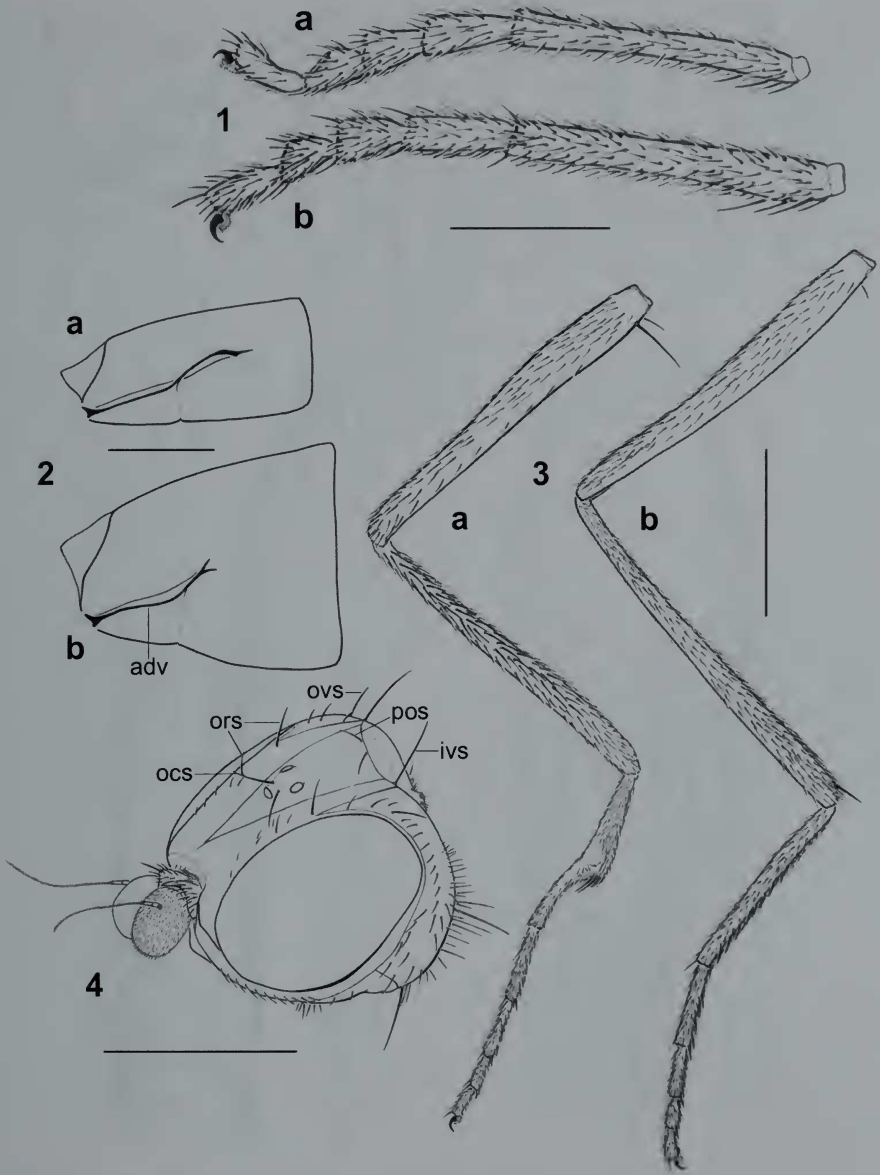
- any discernible swelling or darkening at junction of veins CuA<sub>1</sub> and dm-cu. Male mid basitarsus simple .....*S. angustipennis* Melander
- Frons usually entirely black, at most narrowly brown anteriorly. Only the posterior notopleural seta present but with additional pale short setulae. Setae of head and thorax mostly black. Femora mostly black, at most somewhat paler apically. Wing with darkening and/or swelling at junction of veins CuA<sub>1</sub> and dm-cu, swelling absent to medium-sized in female (Figs. 13–15) but large in male (Fig. 12). Male mid basitarsus curved and with angular anteroventral projection (Figs. 3a, 16–18).....  
.....*S. pengellyi* new species

*Strongylophthalmyia pengellyi* runs to *S. pictipes* in Shatalkin's (1993) key to Palaearctic species. Besides three obvious characters unique to *S. pengellyi* (one notopleural seta, discrete darkening of the veins or black spot at the junction of veins CuA<sub>1</sub> and dm-cu, modified mid basitarsus of the male), it can be distinguished from *S. pictipes* by its entirely dark frons in both genders and the complete absence of a dark median band in the wing in either gender. Steyskal's (1971) outdated key to World species (missing *S. pictipes*) gives more ambiguous results because of alternative possible interpretations of the colour of the postpronotum. If the postpronotum is considered black (usually but ranges from brown to black), then *S. pengellyi* will run to the Southeast Asian species *S. nigricoxa* (de Meijere). I have not seen specimens of *S. nigricoxa* (known from Java and Sumatra) but Steyskal (1971), Frey (1956), and de Meijere (1914) would have noted at least one of the striking characters listed here as autapomorphies of *S. pengellyi* if they were found in *S. nigricoxa*.

***Strongylophthalmyia pengellyi* new species** (Figs. 1–24)

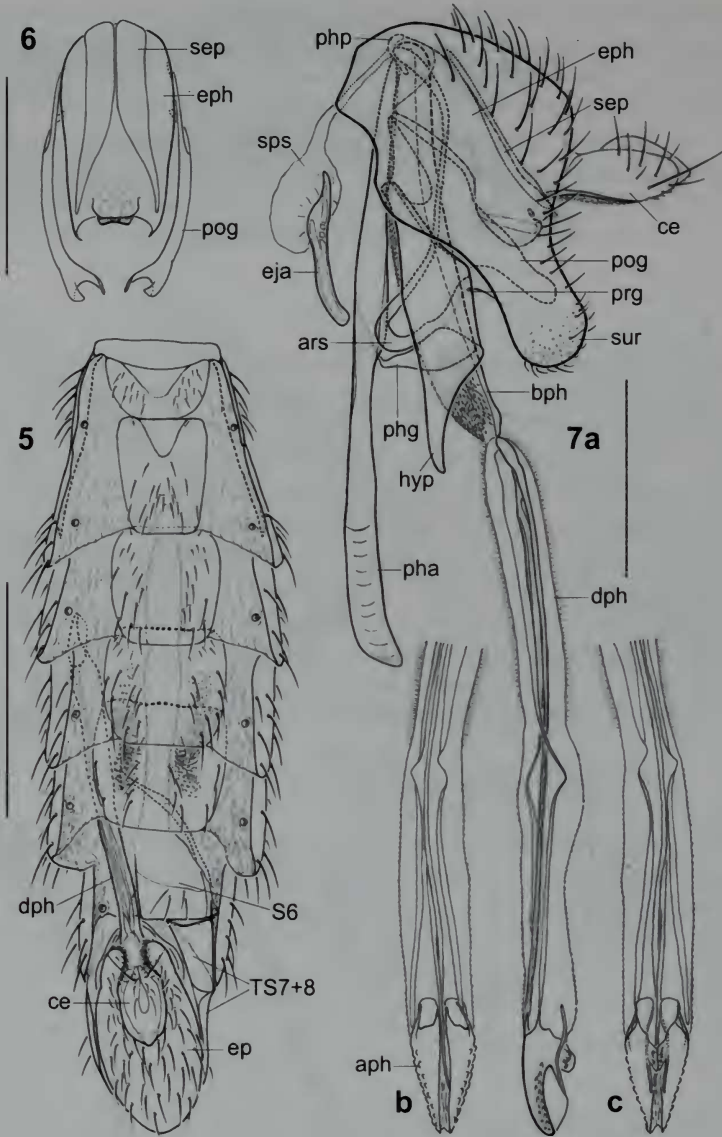
**Diagnosis.** Small (2.7-5.0 mm) elongate flies with long slender legs; mostly black except for reddish-brown eye, brown to yellow parts of antenna, face, parafacial, prosternum, front coxa, front knee, apex of front tibia and tarsi, and white gena and halter knob. Mid basitarsus of male highly modified. Wing hyaline with brown veins, diffuse apical cloud usually present but better developed in male; junction of veins CuA<sub>1</sub> and dm-cu expanded into a raised black spot in male, reduced or absent in female. Setae mostly black and setulae mostly pale; notably only a single (posterior) notopleural seta present (setae generally shorter than those in *S. angustipennis*).

**Male description.** 2.69-3.86 mm long. **Head** (similar to Fig. 4: female). Length about 1.1-1.3X height, tapering to antenna, occiput inflated posterolaterally; in frontal view widest at mid-height of eye, width about 1.4-1.5X height. Frons shiny black with fine longitudinal striations, sometimes narrowly brown on apical margin (yellow to ocellar tubercle in *S. angustipennis* male, at least halfway in female); subquadrate, narrowing slightly anterior to ocelli, widening more abruptly above; in profile, anterolateral corners projecting above margin of eye. Ocellar triangle more coarsely striate dorsally, apex reaching about 2/3-3/4 distance from anterior ocellus to frontal margin; ocellar tubercle displaced anteriorly from postocellar setae by about 1.5X its length. The convergent inner vertical setae are the longest cephalic setae, arising distinctly behind level of postocellars, length subequal to distance

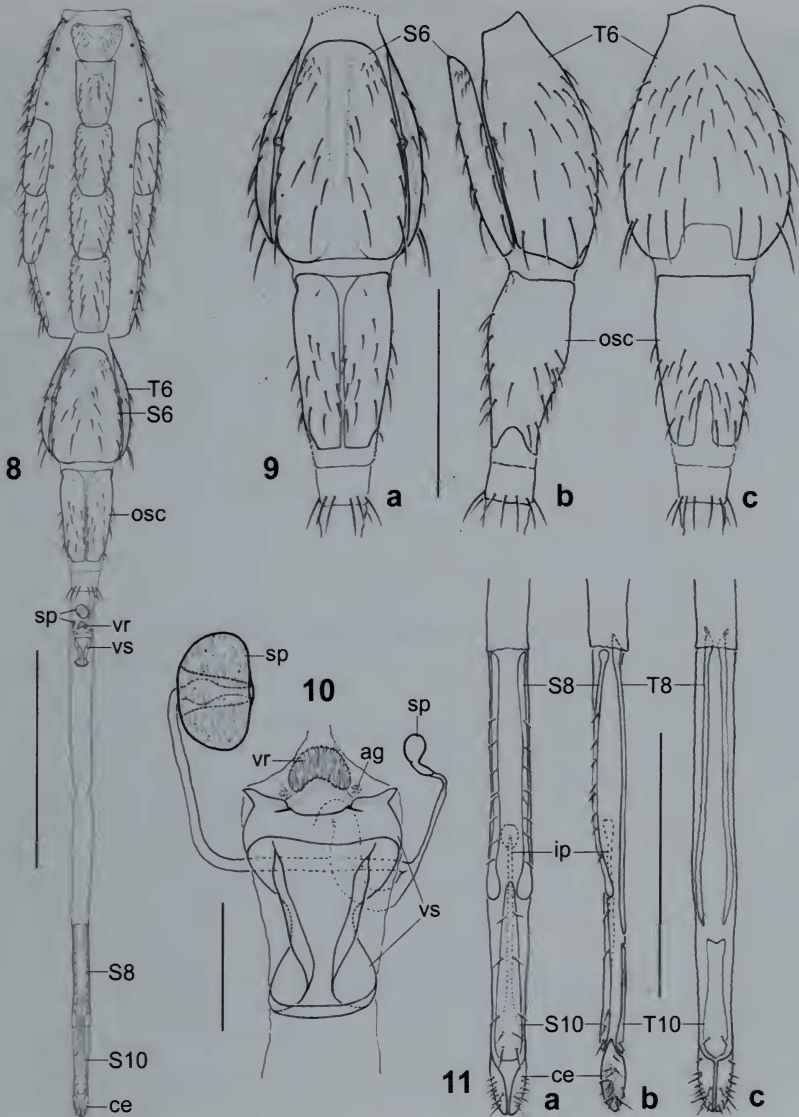


FIGURES 1–4. *Strongylophthalmyia pengellyi* n. sp., head, legs and abdomen. 1–Left front tarsus, posterior view, a) male, b) female (scale bar=0.2 mm). 2–Tergites 1+2 with adventitious suture, left lateral view, a) male, b) female (scale bar=0.2 mm). 3–Left middle leg, posterior view, a) male, b) female (scale bar=0.5 mm). 4–Head, female, dorsolateral view (scale bar=0.5 mm). Abbreviations: adv–adventitious suture, ivs–inner vertical seta, ocs–ocellar seta, ors–orbital setae, ovs–outer vertical seta, pos–postocellar seta.

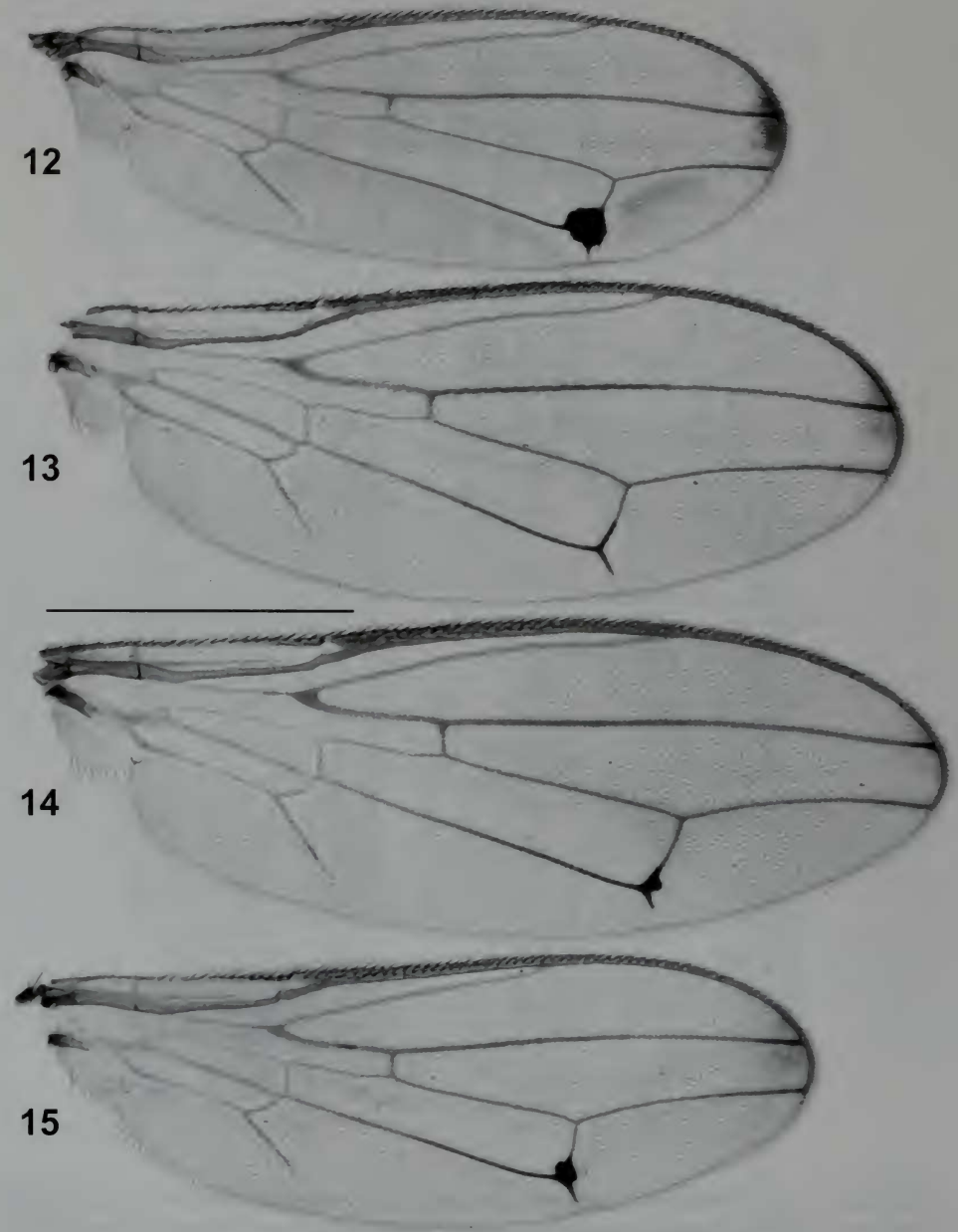




FIGURES 5–7. *Strongylophthalmyia pengellyi* n. sp., male abdomen and genitalia. 5–Abdomen, ventral view (scale bar=0.5 mm). 6–Subepandrial sclerites, epiphallus, and postgonites, posterior view (scale bar=0.2 mm). 7–Genitalia, (scale bar=0.2 mm), a) left lateral view, b) distiphallus, dorsal view, c) ditto, ventral view. Abbreviations: aph–acrophallus, ars–arch-like sclerite of hypandrium, bph–basiphallus, ce–cercus, dph–distiphallus, eja–ejaculatory apodeme, ep–epandrium, eph–epiphallus, pha–phallapodeme, phg–phallic guide, php–phallopore, pog–postgonite, prg–pregonite, sep–subepandrial sclerite, sps–sperm pump sac, sur–surstylus.

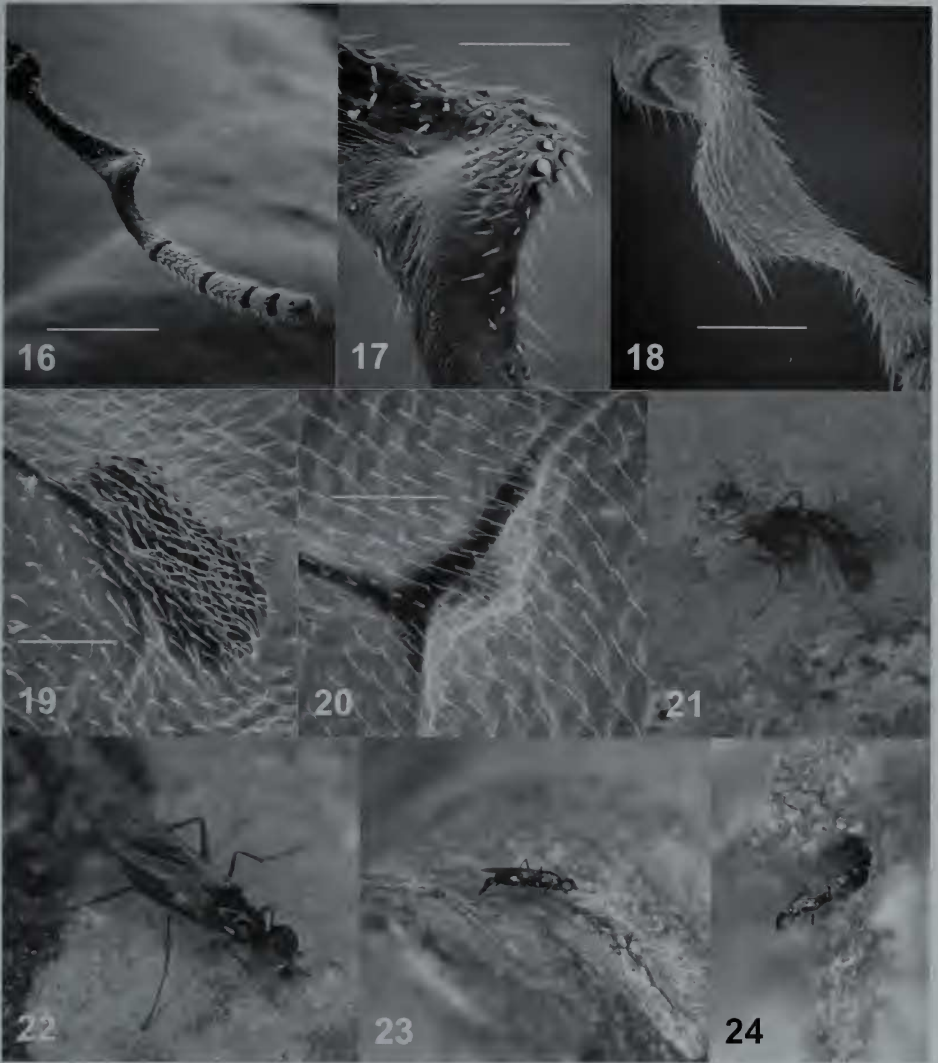


FIGURES 8–11. *Strongylophthalmyia pengellyi* n. sp., female abdomen and genitalia. 8–Abdomen with ovipositor extended, ventral view (scale bar=1.0 mm). 9–Segments 6 and 7 a) ventral view, b) left lateral view, c) dorsal view (scale bar=0.5 mm). 10–Internal structures including spermathecae, vaginal sclerite, ventral receptacle, and possible sessile accessory glands in dorsal wall, ventral view (scale bar=0.1 mm). 11–Apex of ovipositor with segment 8, tergite 10, sternite 10, and cerci (scale bar=0.5 mm). Abbreviations: ag–accessory gland? (see text), ce–cercus, ip–internal process of S10, osc–oviscape, sp–spermatheca(e), vr–ventral receptacle, vs–vaginal sclerite.



FIGURES 12–15. *Strongylophthalmyia pengellyi* n. sp., male and female wings (dorsal) showing black swelling at junction of  $CuA_1$  and  $dm-cu$  (scale bar = 1.0 mm). 12–Male. 13–15–Female (showing variation).





FIGURES 16–24. *Strongylophthalmyia pengellyi* n. sp., electron micrographs of male mid basitarsus, wings, and photographs of adults in field. 16–17–Male left mid tarsus, 16–Ventral view (scale bar = 176  $\mu$ m), 17–Midventral angulation of basitarsus (scale bar = 38  $\mu$ m). 18–Same, anterodorsal view (scale bar = 75  $\mu$ m). 19–20–Junction of veins  $CuA_1$  and  $dm-cu$  on left wing, dorsal surface, 19–Male (scale bar = 43  $\mu$ m), 20–Female (condition similar to Fig. 14; scale bar = 51  $\mu$ m). 21–Copulation attempt on downed aspen trunk (White River, Ontario, 2003). 22–Female “tasting” surface of downed aspen trunk (ibid.). 23–Female “probing” surface of branch on downed aspen top with ovipositor (Dubreuilville, Ontario, 2003). 24–Female backed into scolytid(?) beetle hole, ovipositor greatly extended but not visible in image (Sault Ste. Marie, Ontario, 2005).

to insertion of postocellar of opposite side. Divergent outer vertical seta about 1/2-2/3 length of inner vertical, arising at about level of postocellars. Postocellar setae divergent, subequal to outer vertical. Proclinate divergent ocellar setae about 1/2-3/4 length of inner vertical. One or two short (subequal to or shorter than lower orbital), black reclinate to laterocline setulae arising between upper orbital and outer vertical (*S. angustipennis* with 1-2 usually pale setulae, 1 often longer than anterior orbital). Two reclinate to laterocline orbital setae: upper orbital subequal to postocellar, arising at about level of posterior ocelli; lower orbital about 1/2-2/3 length of upper orbital arising at about level of anterior ocellus. Three to six pale setulae arising anterior to lower orbital. Anterior margin of frons with about 3-4 pairs of pale setulae above antennae. Occiput convex and setulose but with well-defined concave median occipital plate glabrous except for compact grouping of short black supracerical setulae. Short pale postocular setulae removed from eye margin by own length, continuing ventrally to genal margin. Similarly short pale occipital setulae sparsely scattered especially mediolaterally, much longer ventrally, longest two pale setae at ventrolateral corner and near ventrolateral margin of occipital foramen. Lunule very narrowly exposed, yellowish but darker medially. Parafacial narrowing ventrally, yellow to white, antennal groove yellowish brown, both with brown medial margin, tomentose dorsally; parafacial densely white tomentose ventrally where meeting gena. Medial plate of face brownish yellow, palest centrally, microtomentose (often folded or obscured especially in air-dried specimens). Gena narrow, at its narrowest point subequal to maximum width of palpus; densely microtomentose white with short pale reclinate marginal setulae to and curving above posterior brown (dorsally yellow in *S. angustipennis*) glabrous triangular part; less dense tomentose band on posterior orbit narrowing posterodorsally; triangular part of gena posteriorly wide about 4-5X width of tomentose orbital band (not properly viewed in Fig. 4; only 2.5-3.3X in *S. angustipennis*). Compound eye reddish brown, obliquely elliptical, glabrous. Antenna short, yellowish brown (entirely yellow in *S. angustipennis*) except arista and dorsal portion of flagellomere 1 beyond insertion of arista which are dark brown to black, especially on lateral surface. Scape with short marginal setulae, those on medial surface pale, on lateral surface black. Pedicel with setulae as on scape plus outstanding black setula dorsally. Flagellomere 1 oval, slightly longer than wide, with short pale pilosity. Aristal length equal to anterior frontal width; aristonere 1 inconspicuous, aristonere 2 as long as or slightly longer than wide; cilia of aristonere 3 short, longest about equal to width of aristonere 1 (at least 1.5X width in *S. angustipennis*). Mouthparts black to brown (palpus yellow to apically brown in *S. angustipennis* male), clypeus darkest, membranous parts yellow to brown or grey. Clypeus narrow, medially slightly wider than palpus. Palpus with black apical setulae; other setulae of mouthparts pale.

**Thorax.** Elongate, black to brownish black, somewhat lighter ventrally; prosternum posteriorly yellowish; proepisternum (especially dorsally), postpronotum (sometimes), anepisternum anterodorsally, and supralar area brown, often obscurely. Broad precoxal bridge with posterior microtomentose triangular plates yellowish to brown, glabrous anterior section entirely brown to black (black only on anterior margin in *S. angustipennis*). Proepisternum with several short pale setulae anteroventral to anterior spiracle near coxal insertion. Postpronotum with scattered short pale setulae. Anterior notopleural seta absent (present in *S. angustipennis*); posterior notopleural seta black (rarely pale), subequal to tegular seta; a few short pale setulae present (absent in *S. angustipennis*), similar to

those dorsally on scutum; presutural supra-alar seta absent (sometimes present in *S. angustipennis*). Notum elongate, transverse suture arising at about midpoint. Scutal setulae short (longer in *S. angustipennis*), broadly distributed, mostly pale, those on extreme anterior margin black, slightly longer; presuturally including three distinct bands (one medial and one along each dorsocentral line) of 2-3 indistinct rows each, bands merging anteriorly; postsuturally, acrostichal setulae dispersed in 4 indistinct rows, setulae in dorsocentral lines in a single row, with glabrous strip lateral to dorsocentral lines (as in *S. angustipennis*). The single postsutural dorsocentral seta about 1.5X length of inner vertical, supraalar seta shorter, both black; postalar seta pale, subequal to length of notopleural. Scutellar setae black, in one subapical cruciate pair, about 1.5X length of dorsocentral. Anepisternum posterodorsally with short pale reclinate setulae in broad band narrowing ventrally, and with one outstanding pale seta near hind margin. Katepisternum with pale setulae ventrally and posterodorsally. Anepimeron with 4-5 pale setulae. Meron dorsally with pale setulae (absent in *S. angustipennis*) anterior to those below spiracle.

**Legs.** Elongate, narrow, mostly black to dark brown (in *S. angustipennis*, white to yellow with apices of mid and hind femora brown to black and tarsi darkened to brown apically) except dark brown to yellow front coxa (especially anterior and posterior surfaces), front and mid trochanters, tips of tibiae and all tarsi (apical segments often darker); mid coxa sometimes yellowish on posterior surface. Front knee narrowly brownish yellow dorsally, pale area extending ventrally to about 1/3 of femur and tibia; less distinct in vicinity of joint in other legs. Fine pale setae (about 10) on front coxae not noticeably longer than coxal diameter (about 25-30 in *S. angustipennis*, much longer than coxal diameter in male only); single outstanding pale seta basoventrally on mid (Fig. 3a) and hind femora (*S. angustipennis* male with 3-5 elongate basoventral setae on mid femur, 1 on hind femur, legs otherwise similar to female). Basitarsus of front and mid leg equal in length to combined length of tarsomeres 2-5 (Figs. 1a, 3a), hind basitarsus equalling length of tarsomeres 2-4. Front tarsomere 4 excavated apicodorsally (Fig. 1a; to receive reflexed tarsomere 5?), dorsal length basal of emargination about 1/2 that of ventral length; tarsomere 5 slightly depressed dorsally. Mid tibia apically depressed on anterior surface; setae longer on posterior surface, becoming shorter distally (Fig. 3a), without apicoventral setae (present in *S. angustipennis*). Mid basitarsus highly modified (Figs. 3a, 16-18), arcuate, widening to a broad, flat anteroventral projection at the midpoint, abruptly narrowed and arcuate in distal 1/3; basal 2/3 bearing short strong setulae ventrally, longest and strongest at apicoventral angle of projection (front and mid tarsi and mid tibia of *S. angustipennis* not modified).

**Wing** (Fig. 12). Hyaline, with narrow infusate area (diffuse and indistinct in *S. angustipennis*) surrounding apex of  $R_{4+5}$  widening posteriorly but not reaching M; often with obscure infuscations parallel to veins (more obvious in *S. angustipennis*), especially posterior margin of M and dm-cu; veins mostly brown, black surrounding junction of veins  $CuA_1$  and dm-cu. Distinctive black "spot" or swelling centred on junction of veins  $CuA_1$  and dm-cu, raised above plane of membrane on dorsal surface (Fig. 19), bearing dense microtrichia on both surfaces (veins unmodified and all brown in *S. angustipennis*). Costa running to apex of M; sector of  $CuA_1$  between bm-cu and  $CuA_2$  usually reduced or absent. Crossvein rm arising at basal 1/3 or less of cell dm. Cell dm elongate, reaching to level of apex of  $R_{2+3}$  or beyond; distal portion of M slightly to strongly arcuate, parallel to  $R_{4+5}$  in distal 1/3. Costagial seta absent; tegula with one outstanding seta. Vein  $A_1$  not reaching



wing margin. Calypters (as in *S. angustipennis*) whitish; basal marginal cilia of upper calypter pale as long as anepisternal seta, distal cilia shorter and grey. Halter with pale brown stem and white knob.

**Abdomen** (Fig. 5; similar to *S. angustipennis*). Shiny black with black setae; elongate. T1–T6 without setae in midline, broadly so on T1+2. T1+2 about 1.5X as long as basal width, with lateral, adventitious suture extending posteriorly to level of spiracle 2 (Fig. 2a). T3–T5 each about 1/2 length of T1+2. Pleural membranes densely covered in dark grey to black appressed microtrichia. S1 short, trapezoidal, broadly and deeply emarginate anteriorly producing anterolateral arms or projections; sparsely setose except medial sclerotization weak and glabrous often appearing emarginate posteriorly. S2 elongate, trapezoidal, anteromedially emarginate and weakly sclerotized and slightly depressed posteromedially (appearing H-shaped when cleared), setose on posterior half but glabrous in posteromedial weak area, anterolateral corners deflected dorsally. S3–S4 roundly quadrate to trapezoidal, medially weak and depressed except for narrow anterior margin, setose except for glabrous medial area, setae in anterolateral corners shorter; S4 sometimes with a few scattered spicules in middle of lateral setose areas (as in Fig. 5). S5 similar but slightly asymmetrical (shorter right side, lip of genital pouch), setose laterally except for elongate patch of dense short spicules on either side of medial area, concave within and lateral to these patches.

**Terminalia** (Fig. 5; similar to *S. angustipennis*). T6 slightly longer than each of T3–T5, slightly asymmetrical, shorter on right side. Spiracle 6 near midpoint of T6. S6 strongly asymmetrical, with oblique heavily sclerotized anterior margin bearing right sensory setula at apex of anteromedially flexed right margin (in medial wall of genital pouch), left sensory setula at midline. S6 running posterodorsally to fuse with anterior margin of TS7+8; broad posterior portion bearing two groups of 2-6 setae left of midline, those in right group slightly longer; glabrous right side weak, concave, receiving base of aedeagus. Genital pouch opening at right posterior margin of S5 and extending into segment 3 on right side. TS7+8 asymmetrical, slightly longer than T6 on dorsal midline, about 1.4X its length on left side; setose but without elongate setae of T1–T6; incision on left ventral margin; left anteroventral margin heavily sclerotized bearing right sensory setula at apex and left sensory setula laterally.

**Genitalia** (dorsal and ventral in reference to the aedeagus is made from copulatory position—Fig. 7a; similar to *S. angustipennis* with minor differences in shape). Eandrium (Fig. 7a) with short setae as in TS7+8. Surstylus a simple elongate, basally narrowed and distally rounded lobe, fused with eandrium; setae along posterior margin shorter apically; setulae densely clustered on inner surface of apex. Cercus elongate with angular apex, widest at middle; sclerotization weakening posteriorly; apical portion setose with one outstanding preapical seta. Pair of narrow vertical subepandrial sclerites (Figs. 6, 7a) closely appressed to posterior surface of epiphallus (in retracted position), running from near base of epiphallus, narrowing and diverging to anterior bases of cerci. Hypandrium relatively short, U-shaped, articulating posterolaterally with eandrium; short mediadorsal extensions articulating with phallapodeme to form phallic guide; additional mediadorsal arch-shaped sclerites looping dorsally then posteriorly as thin ribbons to base of basiphallus and phallapodeme. Pregonite obscure, fused with hypandrium, bearing single seta near medioventral angle (base of arch-shaped sclerite). Postgonite apically narrowing and bifurcate (posterior view, Fig. 6), apex of outer process a short broad point. Epiphallus broad, with angular anterobasal corners

meeting posterior bases of postgonites, narrowing in middle (lateral view, Fig. 7a), with complex apex; anterior surface concave but with raised, medial projection leading to an obliquely posteriorly flexed, heavily sclerotized medial apex; posterior surface broadly convex with a sclerotized, apically setulose, apical convex tab (Fig. 6), which in turn has a subapical anteromedial projection meeting the heavily sclerotized medial apex of the anterior surface. Basiphallus simple, gradually widened apically (in lateral view, Fig. 7a), ventral surface sclerotized especially marginally and apically, otherwise membranous with strong dense proclinate microtrichia; phallopore small, J-shaped in profile. Distiphallus long, extending into abdominal segment 3 (Figs. 5, 7), mostly membranous with fine and sparse microtrichia, erect in basal half, reclinate in apical half; 3 internal ribbon-like sclerites arising at base of distiphallus ventrally, eventually terminating dorsomedially and dorsolaterally at acrophallus; “medial” sclerite basally broader than other two, actually originating on left side and continuing toward dorsal surface, longitudinally split in apical 1/4, terminating in dorsomedial separation in acrophallus (Fig. 7b); 2 lateral ribbon-like sclerites arising to right side of “medial” sclerite, these cross over bringing most lateral sclerite (on right side) to the left side, the other from the middle to the right side, both continuing to base of acrophallus but weakened and bent at midpoint (a flexure or torsion point; more distal in *S. angustipennis* at about 0.6 of length). Acrophallus dominated by pair of heavily sclerotized hook-like sclerites that are laterally serrate in apical 2/3, with thin basal projections dorsomedially and dorsolaterally (Figs. 7a, b), the latter meeting the lateral ribbon-like sclerites of the distiphallus; basoventrally converging as blunt tab (Figs. 7a, c); pair of internal ventral plate-like sclerites, sinuate in lateral view (Fig. 7a), greatly narrowed apically and fusing laterally with ventral tab. Phallopodeme simple, rod-like, very elongate; sclerotization weaker apically and at articulation with phallic guide. Ejaculatory apodeme with narrow blunt anterior end, arrowhead-shaped posterior end (viewed dorsally), latter with 5-7 pores, supporting sperm pump sac.

**Female description.** Similar to male with the following variances. 2.95-4.75 mm (to apex of segment 7). **Head** (Fig. 4). 1-3 small setulae above upper orbital (1-2 in *S. angustipennis*, as in male). Ocellar seta about 1/2-2/3 length of inner vertical. 3-9 small setulae anterior to lower orbital, occasionally with one above the lower orbital. Ventral postoccipital setae shorter, with outstanding pale seta near foramen but long seta near ventrolateral corner black (pale in *S. angustipennis*). Glabrous portion of gena rarely with 1-2 short proclinate setulae (as in Fig. 4). Flagellomere 1 often more extensively darkened, only a narrow band of yellow basally (entirely brown to centrally yellow in *S. angustipennis*).

**Thorax.** Notopleural seta always black (pale in *S. angustipennis*).

**Legs** (not modified, similar in structure to *S. angustipennis*). Tarsi more often more extensively darkened. Mid (Fig. 2b) and hind femora lacking outstanding basoventral seta. Front tarsus not modified (Fig. 1b), tarsomere 4 not strongly excavated apicodorsally with basodorsal length more than 1/2 of ventral length; tarsomere 5 not depressed (but sometimes as an artifact of desiccation). Mid tibia (Fig. 2b) without enlarged setae on posterior surface; without apical depression on anterior surface; with posterior apicoventral seta about 0.8-1.5X apical width of tibia, yellow or black, sometimes with shorter anterior apicoventral seta (both strong in *S. angustipennis* female, weaker in male). Mid basitarsus not modified (Fig. 2b), similar to front and hind leg but with elongate ventral setae in basal 1/3 absent.

**Wing** (Figs. 13–15). Infuscations less developed or absent (female and male more similar in *S. angustipennis*—Steyskal 1987b, p. 777, Fig. 59.1). Apical cloud smaller or absent, usually present only as small indistinct infuscation surrounding the apex of  $R_{4+5}$ . Junction of veins  $CuA_1$  and dm-cu with veins darkened (Fig. 13), often with small black projection posteriorly (Figs. 14, 20), rarely larger (Fig. 15) but never as large as in male. Cell dm of more variable length, crossvein dm-cu sometimes not (Fig. 13) reaching level of apex of  $R_{2+3}$ ; crossvein rm arising at basal 1/3 to 2/5 of cell dm.

**Abdomen** (Fig. 8; similar to *S. angustipennis*). Broader than in male; largest setae not as well developed. T1+2 with length about 1.9X basal width; adventitious suture more angular at junction of T1–T2, shorter and not reaching level of spiracle 2; medial bare area of T1 portion larger. T5 narrowing posteriorly. S1–S2 lacking posteromedial weakening, S2 not appearing H-shaped. S3–S5 more elongate, medially glabrous but not weakened or depressed. S4–S5 symmetrical, lacking short spicules or lateral depressions.

**Terminalia and genitalia** (similar to *S. angustipennis*). Segment 6 about 1.5X length of segment 5 (Figs. 8–9); T6 dorsally domed, urn-shaped, narrowest basally with narrow reflexed anterior margin, widest in apical third, posterior margin with shallow trapezoidal medial emargination (Fig. 9c). S6 widening apically, setation similar to S3–S5 (Fig. 9a). Segment 7 with T7 and S7 fused to form sclerotized oviscape in basal 3/4, apical 1/4 membranous with posteromarginal ring of about 10 setae; oviscape with narrow weakening on ventral midline, widening to anterior notch (Fig. 9a), widest in basal 1/3, tapering apically, setulae more numerous posterodorsally and posteroventrally, small depression laterally near base, posterior margin with emarginations laterally (Fig. 9b) and dorsomedially (Fig. 9c). Eversible narrow ovipositor sheath (connecting segments 7–8), about 2.7X length of segment 7. Segment 8 slightly shorter than segment 7 (Figs. 8, 11). T8 a pair of ribbon-like sclerites with twisted spatulate bases and acute apices (Fig. 11c). S8 a pair of shorter ribbon-like sclerites, curving dorsally at bases and apices (Fig. 11b), basal tips blunt and apical tips spatulate, each with a series of widely spaced setulae (Fig. 11a). T10 elongate, with slight basal emargination, apical 1/3 ovoid with apical point, with a pair of preapical setulae (Fig. 11c). S10 longer than T10, running basomedial to apices of S8; margins ill-defined but broadly rounded apically, tapering to acute base; 5 pairs of setulae, apical pair about 2X length of others; internal medial process continues basally beyond apices of S8, ending in spatulate tip (Fig. 11a). Cerci elongate, sclerotized, fused medially but narrowly desclerotized along midline both dorsally and ventrally; setulose especially laterally where sclerotization is weak or lacking (Fig. 11). Sclerotized, short subcylindrical spermatheca with deep apical invagination, a second much reduced spermatheca (sometimes not sclerotized) and duct, the two ducts joining before entering the vagina dorsally (Fig. 10). Pair of sessile, granular structures basolateral to insertion of spermathecal duct (possibly accessory glands). Ventral receptacle tapered-reniform with annular corrugations. Vaginal sclerite broad, anteroventrally convex with ventral and lateral projections on anterior margin (Fig. 10); continuing posterolaterally as pair of weakly sclerotized, twisted plates joined posteriorly by weak narrow band in ventral wall.

**Discussion of morphology.** According to McAlpine (1989), loss of the anterior notopleural seta is a groundplan feature of group II of his Diopsoidea (including families Somatiidae, Psilidae, Nothybidae, Megamerinidae, Syringogastridae, and Diopsidae). It is interpreted



as a convergent condition and autapomorphy of *S. pengellyi*.

Steyskal (1987b) refers to the presence of three orbital setae in *S. angustipennis*. This condition is only slightly different from that in *S. pengellyi* where one of the setulae above the upper orbital seta can be quite long. This third “orbital” is clearly shorter than the upper orbital and is interpreted to be an enlarged setula in this position. Papp et al. (2006) interpret enlarged setulae above the second orbital as additional orbital setae and describe a similar condition in *S. palpalis* Papp where the “middle” orbital is the longest. Other Southeast Asian species have additional developed setulae/setae interpreted as orbitals or otherwise (e.g. 4 orbitals in *S. macrocera* Papp; 3 orbitals and “an additional lateral vertical/occipital seta” in *S. thaii* Papp (Papp et al. 2006)). The homology of these setae should be investigated in the context of this modified area of the head.

The pigmented swelling at the junction of veins CuA<sub>1</sub> and dm-cu may be developmentally achieved by a controlled enlargement of the veins in this area. The thickness of the swelling is similar to that of the veins and the density of microtrichia is more similar to their distribution on the veins than the membrane. The dark pigmentation is limited to the swelling and the neighbouring portions of the veins.

All reports of *Strongylophthalmyia* indicate a single sclerotized spermatheca. The vestigial second spermatheca found here in *S. pengellyi* (also present in *S. angustipennis*) is the first such record in the family. The interpretation of the sessile structures embedded in the dorsal wall of the vagina as accessory glands is tentative. No ducted structures were found which could be interpreted as accessory glands.

Steyskal's (1987b, p. 778, Fig. 59.3) illustration of the distiphallus of *S. angustipennis* is incomplete. The distal portion of the distiphallus, including the acrophallus, is missing as a result of partial removal of the abdomen (personal observation of dissected specimen used for this illustration revealed the apical portion of the distiphallus still embedded in the base of the abdomen—CNCI). The acrophallus is very similar to that in *S. pengellyi* but the flexure or torsion point is more distal, at about the 0.6 level of the distiphallus (including acrophallus) compared to the 0.5 level in *S. pengellyi*.

The aedeagus is illustrated here with the tips of the acrophallus pointing ventrally (Fig. 7a). At rest in the genital pouch (right side), they are pointing medially (Fig. 5) and must be rotated 90° around the long axis of the distiphallus to the illustrated copulatory position (see discussion below regarding mating behaviour). The juxtaposition of the bases of the three internal sclerites of the distiphallus suggests that the distiphallus has undergone some structural rotational modifications to assist this.

**Type Material Examined: Holotype male:** “CAN: ON: ~13.6 km S Hawk Jct., Hwy #101, 17.vi.2004, K. N. Barber, pooter, bleeding *Populus* 47°58.15'N 84°31.81'W”, “HOLOTYPE ♂ *Strongylophthalmyia pengellyi* n.sp. K. N. Barber 2006”, intact (CNCI).

**Paratypes: CANADA, New Brunswick:** Kouchibouguac N[ational] P[ark], 9 July 1977, J. F. McAlpine, Code-6023Q, ♀ (CNCI). **Ontario:** Same data as holotype, ♂, 4♀ (CNCI); ~8.4 km SW Chapleau, Hwy #101, 17 June 2004, pooter, fresh *Populus* log, 47°46.41'N 83°28.11'W, K. N. Barber, 7♀ (DEBU); ~14 km W Cochrane, 7 June–9 July 2004, opaque mini sticky traps, mostly *P. tremuloides*, 49°03.1'N 81°12.1'W, L. Rowlinson, 5♂, 40♀ (BYUC, DEBU, UBCZ); ~35 km WSW Dubreuilville, 1.8 km W Jct. Hwys. #17 & #519, boreal mixedwood, pooter, downed *Populus* top, 48°17.46'N 84°54.08'W, K. N. Barber,

17 June 2003, 5♀, 23 June 2003, 4♂, 7♀, 7 July 2003, 4♀, 6 July 2004, ♀; same location but dieing [sic] *Populus* trunk, 23 June 2003, 5♂, 2♀, 7 July 2003, ♀; same location but 15 June 2004, live *Populus* trunk, ♀; same location but 27 June 2005, standing aspen, ♂, 3♀, downed aspen snag, 3♀ (all DEBU); same location but 15 June–6 July 2004, opaque mini sticky traps, K. N. Barber, 11♂, 73♀ (DEBU, LACM, ROME); ~38 km W Hearst, 8 June–9 July 2004, opaque mini sticky traps, mostly *P. tremuloides*, 49°44.7'N 84°09.9'W, L. Rowlinson, ♀; Hwy #17, ~2.5 km E McKerrow, opaque mini sticky traps, mixed forest, 46°17.5'N 81°42.9'W, K. N. Barber, 12–20 June 2004, 2♂, 4♀, 20 June–2 July 2004, 5♀; Hwy #17, ~4.7 km W Pancake Bay P[rovincial] P[ark], 15 June–6 July 2004, opaque mini sticky traps, mixed forest, 46°57.98'N 84°44.49'W, K. N. Barber, 11♀; S[ault] S[te.] Marie, Baseline Rd., pooter, downed *Populus tremuloides*, 46°31.40'N 84°24.40'W, K. N. Barber, 31 May 2005, ♀, 7 June 2005, ovipositing in beetle hole, ♀; same location but transluc[ent][sic] mini sticky trap [trap # excluded], nr. downed *Populus tremuloides*, 46°31.40'N 84°24.40'W, K. N. Barber, 21 May–7 June 2005, ♀, 7–22 June 2005, ♂, 4♀, 22 June–8 July 2005, ♀, 8–22 July 2005, 2♀; SSMarie, Sault Coll[ège] Outdoor Lab, 46°32.06'N 84°18.35'W, pooter, old *Populus* slash, K. N. Barber, 13 July 2004, ♀, 16 July 2004, on *Aralia nudicaulis* nr. old *Populus* slash, ♀; SSMarie, Finn Hill, pooter, aspen trunks, 46°31.53'N 84°17.31'W, K. N. Barber, 12 June 2005, 2♂, ♀, 13 June 2005, 2♂, 2♀; ~6.1 km SE Shabaqua Corners, 8 June–13 July 2004, opaque mini sticky traps, mostly *P. tremuloides*, 48°34.8'N 89°49.2'W, M. Francis, 3♂, 5♀; The Shoals P[rovincial] P[ark], Prairie Bee, 17 June 2004, pooter, seasoned downed *Populus*, 47°52.29'N 83°53.62'W, K. N. Barber, ♀ (DEBU #01500192); ~95 km NNE Thessalon, Hwy #129, 18 June 2004, pooter, *Populus* trunks, K. N. Barber, 47°05.00'N 83°09.40'W, ♂, 5♀, 47°05.05'N 83°09.43'W, ♂, 4♀; ~11.4 km N Wawa, Hwy #17, 6 July 2004, pooter, fresh *Populus* log, 48°04.26'N 84°48.45'W, K. N. Barber, ♀; White River, St. Basil's School, 16 June 2004, pooter, standing *Populus* trunks, 48°35.58'N 85°16.72'W, K. N. Barber, ♂, ♀ (all DEBU); 27 km SSW White River, boreal mixedwood, opaque sticky trap, S. B. Holmes, [trap # excluded], 25 June–16 July 2002, B1 S3, 48°21.0'N 85°20.7'W, 2♀, B1 S4, 48°21.1'N 85°20.7'W, 2♀, B1 S5, 48°21.2'N 85°20.7'W, ♀, B1 S8, 48°21.0'N 85°20.8'W, 2♀, 16 July–7 August 2002, B1 S6, 48°21.2'N 85°20.9'W, ♂, ♀, 26 May–16 June 2003, B1 S1, 48°21.1'N 85°20.5'W, ♂; as above but 30 km SSW White River, 25 June–18 July 2002, B2 S3, 48°19.5'N 85°20.7'W, 2♂, 17♀, B2 S4, 48°19.7'N 85°21.0'W, 2♂, 4♀, B2 S6, 48°19.6'N 85°21.2'W, ♀, 16 June–7 July 2003, B2 S3, ♂, ♀, B2 S4, 3♀, 7–28 July 2003, B2 S4, ♀; as above but 37 km SSW White River, 26 June–16 July 2002, B4 S1, 48°16.5'N 85°23.3'W, 9♀, B4 S3, 48°16.4'N 85°23.6'W, 2♀, B4 S4, 48°16.2'N 85°23.3'W, 3♀, B4 S6, 48°16.4'N 85°23.2'W, 2♀, B4 S7, 48°16.4'N 85°23.1'W, ♂, 5♀, 27 May–17 June 2003, B4 S3, 2♀, B4 S7, 2♂, 17 June–8 July 2003, B4 S1, ♀, B4 S3, 3♂, 2♀, 8–29 July 2003, B4 S3, 48°16.4'N 85°23.6'W, ♀ (all DEBU); as above but 38 km SSW White River, 24 June–17 July 2002, B5 S1, 48°15.1'N 85°23.8'W, 7♂, 8♀ (CNCI), B5 S3, 48°15.2'N 85°23.6'W, 2♀, B5 S5, 48°15.2'N 85°23.9'W, ♂, 7♀, B5 S8, 48°15.3'N 85°24.0'W / 48°15.3'N 85°23.9'W, 3♀, B5 S9, 48°15.3'N 85°23.9'W, ♀, 17 July–8 August 2002, B5 S1, ♀, 27 May–17 June 2003, B5 S5, ♀, B5 S9, ♀, 17 June–8 July 2003, B5 S5, 2♀, B5 S9, ♀; as above but 40 km SSW White River, 25 June–19 July 2002, B6 S1, 48°13.9'N 85°22.2'W, 12♀, B6 S2, 48°14.0'N 85°22.1'W, ♀ (all DEBU), B6 S3, 48°14.0'N 85°22.0'W, 4♂, 19♀ (EMUS), B6 S4, 48°14.1'N 85°22.0'W, 15♀, B6 S6, 48°14.0'N 85°22.3'W, 2♀, B6

S7, 48°14.1'N 85°22.4'W, 3♂, ♀, B6 S8, 48°14.1'N 85°22.4'W, ♀, B6 S9, 48°14.2'N 85°22.1'W, 2♂, 8♀, 19 July–9 August 2002, B6 S3, ♀, 27 May–17 June 2003, B6 S2, ♀, B6 S4, ♂, 17 June–8 July 2003, B6 S1, ♀, B6 S4, 3♀, B6 S7, ♂, 2♀; as above but multi-colour sticky trap, K. N. Barber, [trap # excluded], 29 May–12 June 2003, B6 S1, 48°13.9'N 85°22.2'W / 48°14.0'N 85°22.2'W, 2♂, 4♀, B6 S3, 48°14.0'N 85°22.0'W / 48°14.1'N 85°22.0'W, 3♂, 9♀ (all DEBU), B6 S4, 48°14.1'N 85°22.0'W, 4♂, 8♀ (GLFC), B6 S9, 48°14.2'N 85°22.1'W / 48°14.2'N 85°22.2'W / 48°14.3'N 85°22.1'W, 19♂, 10♀, 12–16 June 2003, B6 S1, 4♂, 5♀, B6 S3, 2♂, 19♀, B6 S4, 4♂, 15♀, B6 S9, 19♂, 12♀, 16–26 June 2003, B6 S1, 17♂, 17♀ (all DEBU), B6 S3, 31♂, 60♀ (AMNH, CNCI, USNM), B6 S4, 14♂, 46♀, B6 S9, 69♂, 29♀, 26 June–10 July 2003, B6 S1, 6♀, B6 S3, 3♂, 21♀, B6 S4, 4♂, 27♀, B6 S9, 8♂, 10♀, 10–23 July 2003, B6 S1, 4♀, B6 S3, ♂, 6♀, B6 S4, ♂, 8♀, B6 S9, 2♂, 2♀; 25 June–9 July 2003, B6 S3, 48°14.04'N 85°21.99'W, 2♂, 10♀, 48°14.07'N 85°21.98'W, ♂, 26♀; as above but Malaise trap, B6 S3A, 48°14.06'N 85°21.97'W, 29 May–11 June 2003, ♀, 11–24 June 2003, 10♀, B6 S3B, 48°14.08'N 85°22.02'W, 13–24 June 2003, ♀, B6 S3C, 48°14.05'N 85°21.98'W, 14–24 June 2003, ♂, 15♀, 24 June–7 July 2003, 2♀, B6 S4, 48°14.13'N 85°22.01'W, 11–24 June 2003, ♂, ♀, 24 June–7 July 2003, 2♀, B6 S9, 48°14.23'N 85°22.15'W, 11–24 June 2003, ♀; as above but B6 S4, 48°14.14'N 85°22.02'W, pooter, on downed *Populus* trunk, 24 June 2003, 3♂, 13♀, 7 July 2003, ♀; as above but B6 S3, 48°14.05'N 85°21.98'W, 7 July 2003, on opaque plastic on ground, ♀; as above but B6 S9, 48°14.23'N 85°22.16'W, 16 June 2003, pooter, base of dead *Populus*, ♀, 24 June 2003, on white net on ground, pooter, ♀ (all DEBU). **Québec.** La Ferme, A. Robert, 11 July 1943, ♀, 16 July 1943, ♂ (CNCI). **UNITED STATES, Michigan: Charlevoix Co.,** ~13 km S Petoskey, Hwy. 131, 20 June 2005, pooter, live aspen trunk along railway, 45°14.40'N 84°54.97'W, K. N. Barber, ♀; **Chippewa Co.,** S[ault] S[te.] Marie, Lake Superior St[ate] U[niversity], 4 June 2005, pooter, K. N. Barber, 46°29.36'N 84°22.09'W, live aspen trunk, ♀, dead aspen snag, 2♀, 46°29.31'N 84°22.06'W, downed aspen top, ♀; **Emmet Co.,** Mackinaw St[ate] For[est], Linsley Rd. nr. Jct. Hwy. 31, 20 June 2005, pooter, live aspen trunk, 45°43.44'N 84°44.73'W, K. N. Barber, ♀ (all DEBU). **Utah:** Cache Co., Logan Canyon, Twin Creek, 15–22 July 1988, W. J. Hanson, ♀; Cache Co., Mendon Cold Spring, 20 June–4 July 1977, Malaise trap, ♂, 3♀; Cache Co., Tony Grove Creek, 29 June–8 July 1994, W. J. Hanson, ♀ (all EMUS); Utah Co., 4 mi N Aspen Grove, “1-XIII-1975” [sic 1.viii.1975?], *Populus tremuloides* infested with *Procryphalus mucronatus*, J. L. Petty, ♀, [additional label reading:] *Populus tremuloides* infested with *Trypophloeus populi*, 2♀ (CNCI).

**Other Material Examined (damaged): CANADA, Ontario:** ~14 km W Cochrane, 7 June–9 July 2004, opaque mini sticky traps, mostly *P. tremuloides*, 49°03.1'N 81°12.1'W, L. Rowlinson, 4♀; ~35 km WSW Dubreuilville, 1.8 km W Jct. Hwys. #17 & #519, 15 June–6 July 2004, boreal mixedwood, opaque mini sticky traps, 48°17.46'N 84°54.08'W, K. N. Barber, 2♀; ~6.1 km SE Shabaqua Corners, 8 June–13 July 2004, opaque mini sticky traps, mostly *P. tremuloides*, 48°34.8'N 89°49.2'W, M. Francis, 3♀; 27 km SSW White River, boreal mixedwood, opaque sticky trap, S. B. Holmes, [trap # excluded], 25 June–16 July 2002, B1 S5, 48°21.2'N 85°20.7'W, ♀, 16 June–7 July 2003, B1 S1, 48°21.1'N 85°20.5'W, ♀; as above but 30 km SSW White River, 25 June–18 July 2002, B2 S3, 48°19.5'N 85°20.7'W, 5♀, B2 S4, 48°19.7'N 85°21.0'W, ♀, 16 June–7 July 2003, B2 S4, 2♀; as above



but 37 km SSW White River, 26 June–16 July 2002, B4 S4, 48°16.2'N 85°23.3'W, 3♀, B4 S7, 48°16.4'N 85°23.1'W, 3♀, B4 S8, 48°16.3'N 85°23.2'W, ♀, 17 June–8 July 2003, B4 S3, 48°16.4'N 85°23.6'W, ♂; as above but 38 km SSW White River, 24 June–17 July 2002, B5 S1, 48°15.1'N 85°23.8'W, ♀, B5 S5, 48°15.2'N 85°23.9'W, ♀; as above but 40 km SSW White River, 25 June–19 July 2002, B6 S1, 48°13.9'N 85°22.2'W, 3♀, B6 S3, 48°14.0'N 85°22.0'W, 12♀, B6 S4, 48°14.1'N 85°22.0'W, ♀, B6 S6, 48°14.0'N 85°22.3'W, 2♀, B6 S9, 48°14.2'N 85°22.1'W, ♂, ♀, 19 July–9 August 2002, B6 S4, ♀, 17 June–8 July 2003, B6 S1, ♂, B6 S4, ♂, ♀, B6 S7, 48°14.1'N 85°22.4'W, 2♂, 8–29 July 2003, B6 S4, ♀; as above but multi-colour sticky trap, K. N. Barber, [trap # excluded], 29 May–12 June 2003, B6 S1, 48°13.9'N 85°22.2'W / 48°14.0'N 85°22.2'W, ♂, B6 S3, 48°14.0'N 85°22.0'W / 48°14.1'N 85°22.0'W, ♀, 12–16 June 2003, B6 S1, 2♂, B6 S4, 48°14.1'N 85°22.0'W, ♀, B6 S9, 48°14.2'N 85°22.1'W / 48°14.2'N 85°22.2'W / 48°14.3'N 85°22.1'W, 2♂, 16–26 June 2003, B6 S1, 4♂, B6 S3, 3♂, 6♀, B6 S4, 4♂, 4♀, B6 S9, 10♂, 9♀, 26 June–10 July 2003, B6 S1, 2♀, B6 S3, ♀, B6 S4, 2♀, B6 S9, 2♀, 10–23 July 2003, B6 S3, 2♀; as above but 25 June–9 July 2003, B6 S3, 48°14.0'N 85°22.0'W, ♀ (all DEBU).

### Etymology

This remarkable new species is named in honour of David H. Pengelly, a friend and influential mentor. Dave introduced me to the beauty and diversity of the Insecta and offered the insight that there was more to the animal world than vertebrates. His encouragement and support were unlimited and led to a student curatorial appointment at the University of Guelph's collection with focus on the acalyprate flies. Dave also arranged my first visit to the CNCI where I met renowned dipterists and deepened my knowledge of flies. This support was expanded as I entered into a M.Sc. program under his primary tutelage along with Frank McAlpine and then Steve Marshall. A mix of taxonomy and life history was a common feature of Dave Pengelly's approach to entomology and is reflected in the approach taken in the current paper. During retirement, Dave and Fran Pengelly were always welcoming hosts for visitors to their home outside Erickson, Manitoba—a location where I first collected numerous *Strongylophthalmyia* and *Tanypeza* together. There I took great pleasure and pride in introducing my two children to a man that had such a profound influence on my life. Thank you "D. H."

### Distribution

*S. pengellyi* is known from New Brunswick, Québec, Ontario, Michigan, and Utah. The other Nearctic species, *S. angustipennis*, ranges from British Columbia to Nova Scotia, and south to Wyoming, Michigan, and Massachusetts (Shewell 1965). Based on material examined during this study, California, Utah, and Arizona are added here as new state records. Both species apparently show a northern, transcontinental range within the range of trembling aspen.

### Relationships

Published descriptions of the many species of *Strongylophthalmyia* lack sufficient detail for an adequate analysis of phylogenetic relationships. Shatalkin (1996) recognizes two species groups in the genus: the *crinita*-group (6 species mostly Oriental: India, Burma, Thailand, Vietnam, Taiwan, Japan) defined by the presence of modified epandrial processes



in the males and sexual dimorphism in the palpi, and the *punctata*-group (9 species mostly Oriental: Thailand (including *S. thaii*), Vietnam, Philippines, Taiwan, Russia (Khabarovsk and Maritime Territories)) defined mostly by a dorsal expansion of flagellomere 1 in the male.

None of the defining apomorphies of these putative species groups is found in *S. pengellyi*, *S. angustipennis*, or in the Palaearctic *S. ustulata* and *S. pictipes*, all four species associated with aspen. Along with *S. japonica* Iwasa (Japan, Russia) and *S. caliginosa* Iwasa (Japan), these six species may represent a monophyletic group based on the putative synapomorphy of a haired arista (bare arista in *Nartshukia* and other *Strongylophthalmyia*). Additionally, the former four species share a basally narrowed and apically rounded surstylus. Further, *S. angustipennis* and *S. ustulata* both have mostly pale setae on the head and thorax and numerous elongate fine setae on the lateroventral surface of the front coxae in the male. These putative synapomorphies suggest a sister relationship between these two species (condition of front femur of male not known by author for *S. pictipes*). *Strongylophthalmyia pengellyi* and *S. pictipes* can each be distinguished from their regional counterpart by the shorter hairing on the arista but the phylogenetic interpretation of this putative synapomorphy as well as the structure of the distiphallus in all six species requires further study.

### Biology of *Strongylophthalmyia*

#### Flight period

Table 1 summarizes four sets of capture data for *Strongylophthalmyia* species from sticky traps set in White River and Sault Ste. Marie, ON. According to these data, the flight period of *S. pengellyi* in Ontario appears to be from at least 7 June to 22 July. However, additional field records are as early as 31 May (Sault Ste. Marie, ON) and as late as 1 August (Aspen Grove, UT).

The collections made with large and mini sticky traps represent the only continuous collection data available. All four sets of data similarly indicate that adults of *S. pengellyi* emerge and fly slightly earlier than *S. angustipennis*. Unlike the former, *S. angustipennis* clearly continues to be active as adults through the season until early September which may indicate at least a partial second generation or a protracted emergence. For both species, more females than males were captured.

Six Malaise traps yielded a total of 2 male and 33 female *S. pengellyi* over roughly the same period (29 May to 22 July 2003) as the coloured mini sticky traps (29 May to 23 July 2003) but were prone to disruption by bears. This trapping method also showed a clearly defined peak (2 males, 28 females) during the second sampling period (11-24 June 2003). Captures of *S. angustipennis* began modestly in the second period (1 male, 2 females) and a total of 18 males and 16 females were accumulated by 22 July. Malaise traps collected equivalent numbers of each species of *Strongylophthalmyia* (35:34) compared to about a 12:1 ratio (579:47) in favour of *S. pengellyi* with the coloured mini sticky traps.

#### Captures from mini sticky traps

Table 2 summarizes the captures for *S. pengellyi* on the coloured mini sticky traps. No significant differences were attributable to height above ground for captures of

TABLE 1. Captures of adult *Strongylophthalmyia* spp. with sticky traps near White River (2002, 2003) and in Sault Ste. Marie (2005), Ontario.

White River, Ontario								
2002 – 90 poles (3 m) ~3-week periods beginning:								
Translucent large boards		24-Jun	16-Jul	7-Aug	27-Aug	Total		
<i>S. pengellyi</i>	Male	24	1	0	0	25		
	Female	169	4	0	0	173		
	Total	193	5	0	0	198		
<i>S. angustipennis</i>	Male	2	12	16	33	63		
	Female	3	30	36	37	106		
	Total	5	42	52	70	169		
2003 – 36 poles (3 m) 3-week periods beginning:								
Translucent large boards		26-May	16-Jun	7-Jul	28-Jul	18-Aug	8-Sep	Total
<i>S. pengellyi</i>	Male	9	24	0	0	0	0	33
	Female	9	25	5	0	0	0	39
	Total	18	49	5	0	0	0	72
<i>S. angustipennis</i>	Male	0	1	2	0	1	0	4
	Female	0	4	7	3	3	1	18
	Total	0	5	9	3	4	1	22
2003 – 24 poles (3 m) 2-week periods beginning:								
Coloured <sup>1</sup> mini boards		29-May	12-Jun	26-Jun	10-Jul	Total		
<i>S. pengellyi</i>	Male	29	186	13	4	232		
	Female	32	221	72	22	347		
	Total	61	407	85	26	579		
<i>S. angustipennis</i>	Male	0	2	8	3	13		
	Female	0	3	20	11	34		
	Total	0	5	28	14	47		
Sault Ste. Marie, Ontario								
2005 – 6 poles (1.5 m) 14-17-day periods beginning:								
Translucent mini boards		21-May	7-Jun	22-Jun	8-Jul	22-Jul	8-Aug	Total
<i>S. pengellyi</i>	Male	0	1	0	0	0	0	1
	Female	1	4	1	2	1	0	9
	Total	1	5	1	2	1	0	10
<i>S. angustipennis</i>	Male	0	1	5	0	13	23	42
	Female	0	0	12	47	62	38	159
	Total	0	1	17	47	75	61	201

<sup>1</sup> four colours (translucent, blue, white, yellow) beginning at each of 3 m- and 1.5 m- heights.

TABLE 2. Captures of adult *S. pengellyi* on coloured mini sticky boards over four trapping periods near White River, Ontario (Block 6 - 29 May to 23 July 2003).

Height <sup>1</sup>	Colour	Male				Female				Total						
		1 <sup>2</sup>	2	3	4	1-4	1	2	3	4	1-4	1	2	3	4	1-4
High	Translucent	8	71	4	0	83	4	44	17	6	71	12	115	21	6	154
	Blue	13	45	4	3	65	7	42	14	3	66	20	87	18	6	131
	White	2	18	0	0	20	4	9	6	1	20	6	27	6	1	40
	Yellow	0	5	2	0	7	1	3	0	1	5	1	8	2	1	12
All	23	139	10	3	175	16	98	37	11	162	39	237	47	14	337	
Low	Translucent	4	29	1	0	34	9	54	21	6	90	13	83	22	6	124
	Blue	1	12	0	0	13	4	41	8	1	54	5	53	8	1	67
	White	1	5	1	1	8	3	27	5	1	36	4	32	6	2	44
	Yellow	0	1	1	0	2	0	1	1	3	5	0	2	2	3	7
All	6	47	3	1	57	16	123	35	11	185	22	170	38	12	242	
High + Low	Translucent	12	100	5	0	117 a <sup>3</sup>	13	98	38	12	161 a	25	198	43	12	278 a
	Blue	14	57	4	3	78 b	11	83	22	4	120 a	25	140	26	7	198 b
	White	3	23	1	1	28 b	7	36	11	2	56 b	10	59	12	3	84 c
	Yellow	0	6	3	0	9 c	1	4	1	4	10 c	1	10	4	4	19 d
All	29	186	13	4	232	32	221	72	22	347	61	407	85	26	579	

<sup>1</sup> height of top board in series of 4: "high" is 3m and "low" is 1.5m

<sup>2</sup> two-week trapping periods 1-4 beginning 29 May, 12 June, 26 June, and 10 July, respectively

<sup>3</sup> total catches followed by different letters within a column represent significant differences (Kruskal-Wallis tests followed by Student-Newman-Keuls multiple comparisons,  $\alpha=0.05$ ,  $n=24$ )

males ( $P=0.120$ ; despite apparently larger captures in the high boards—175 vs. 57), females ( $P=0.331$ ), or both genders combined ( $P=0.910$ ).

Comparing the captures by colour, irrespective of height (Table 2, high+low), uncovered highly significant differences for males, females, and both genders combined ( $P<0.001$ ). Trap catches decreased in the following order: translucent > blue > white > yellow. Translucent boards captured significantly more males and total flies than coloured boards, while females were captured in similar numbers as on blue boards. The side-by-side comparison of translucent and blue boards (6 poles each at 1.5 m above ground) yielded 28 *S. pengellyi* (3 males, 25 females) on translucent boards and only 12 females on blue boards.

Based on these results, only short poles (1.5 m with 4 boards) and only translucent mini sticky boards were used in 2004 and 2005. All but the Mattawa site (5 of 6), yielded captures of at least one specimen of *S. pengellyi* for a group of six poles over sample periods ranging from 20 to 35 days (2004). Capture data for Sault Ste. Marie are listed in Table 1 (96 days; 2005). Sticky traps of the design used in this study are an efficient option for assessing an area for the presence of this otherwise cryptic fly. It is possible that the translucent Coroplast boards more closely resemble the pale bark of trembling aspen trees.

#### Adult feeding, oviposition, and ecological relationships

Almost all adults of *S. pengellyi* were collected on aspen trunks with bark still firmly attached or on recently downed logs or large branches. Very few specimens were collected by sweeping on surfaces near downed aspen. Late stages of decomposed aspen logs did not appear to be attractive to either species of *Strongylophthalmyia*. While also found in similar locations, *S. angustipennis* is more often found perching and copulating on the leaves of the herb and shrub layer. Shatalkin (1993) describes similar observations of a pair of Palearctic species known to be associated with aspen: “Unlike *S. ustulata*, which usually occurs on leaves, *S. pictipes* prefers fallen trunks and stumps, on which it is most often captured”. There is a striking parallel to the field observations made on the two Nearctic species.

Oviposition by *S. pengellyi* was never observed but females were often seen “probing” irruptions on the bark of aspen with the ovipositor (Fig. 23). These irruptions included uplifted areas where spore tendrils of *Cytospora* spp. fungi perforated the bark. The same irruptions were often “tasted” with the labellum (similar to Fig. 22) by both genders. Though not quantified in any way, there was an evident prevalence of bleeds caused by these pathogenic fungi as well as by *Entoleuca mammata* (Wahlenberg: Fr.) J. D. Rogers & Y.-M. Ju on the trees, snags, and downed logs and branches of aspen stands yielding adults of *S. pengellyi*. Small bleeds were attractive to both species of fly.

One female *S. pengellyi* was observed backing into a (scolytid?) beetle hole for an extended period of time with her ovipositor greatly extended (Fig. 24). There was also another observation of a female orienting to a beetle hole and walking “excitedly” sideways in an arc with its head oriented to the hole at about a 2 cm distance (Dubreuilville–2005). Both holes were too large to be produced by the scolytid *Procryphalus mucronatus* (LeConte), which was reared from aspen branches (Dubreuilville–2003; first record for Ontario, D. E. Bright, pers. comm.; vouchers deposited at CNCI and GLFC). The holes were more likely made by *Trypodendron retusum* (LeConte). *Trypophloeus populi* Hopkins has not yet been recorded from Ontario or Québec (Wood 1982; Bright 1976).



These latter observations suggest an association of Nearctic *Strongylophthalmyia* with scolytids. The three specimens of *S. pengellyi* from Aspen Grove, Utah were collected on aspen trees attacked by *P. mucronatus* with two indicating the presence of *T. populi* as well. Of the two species of scolytids studied by Petty (1977), *P. mucronatus* is likely too small to produce tunnels or exit holes that would allow adults of *S. pengellyi* to emerge. But since this smaller scolytid is considered to be secondary to attacks by other beetles such as *T. populi* (Petty 1977), emergence exits for flies are not likely to be limited. In this study, I encountered only *T. retusum* (Dubreuilville, including one reared specimen, Sault Ste. Marie, ON, and Sault Ste. Marie, MI), a species also recorded by Petty (1977) from trees attacked by *P. mucronatus*.

Many other insects, especially Diptera (Cecidomyiidae, Dolichopodidae, Empididae, Lonchaeidae, Otitidae, Clusiidae, Odiniidae, Aulacigastridae) and Coleoptera (especially Nitidulidae, Staphylinidae) were encountered on the same aspen surfaces as *S. pengellyi*. Adult *Tachypeza* spp. (Empididae) were often mistaken for *S. pengellyi* but the former have a much faster, erratic movement. Both types of flies might be mistaken for ants by a casual non-entomologist observer.

### Larval habitat

A total of 22 larvae of *Strongylophthalmyia* were obtained from the early collection of aspen bark held in emergence pails (20 May 2005). Eleven of these pupariated and eight produced adults of *S. angustipennis* (6 males, 2 females: formation of puparia 24-27 May; adult emergence 11-15 June). The second collection (2 June 2005) yielded two more larval specimens and 14 adults (10 males, 4 females, adult emergence from 16-29 June 2005) of *S. angustipennis*.

With no evidence to the contrary, it is likely that all the larval specimens that either died or were preserved are also *S. angustipennis* and that the microhabitat of *S. pengellyi* was missed during the sampling. It is nonetheless presumed that both Nearctic species of *Strongylophthalmyia* overwinter as mature or nearly mature larvae under the bark of trembling aspen.

This is the first record of the larva of *S. angustipennis*. It is characterized by biramous anterior spiracles as described for *S. ustulata* (Krivosheina 1984) and for *Tanypeza longimana* Fallén (Foote 1970). No other descriptions of *Strongylophthalmyia* larvae are available but this suggests that biramous anterior spiracles are a groundplan feature of the Strongylophthalmyiidae.

### Movements of wings and abdomen

Both species of *Strongylophthalmyia* were often seen on the same aspen log (White River, Block 6 Site 4). Interactions between genders and species of *Strongylophthalmyia* often involved abrupt forward movements of one or usually both wings. This behaviour was vigorous between females and particularly between male and female (male-male interactions were rarely observed) usually involving runs directed by the female at the circling male.

One observation of a group of *S. pengellyi*, numbering about 8 specimens of mixed gender, was made on a small aspen tree of about 20 cm diameter (DBH) (Thessalon). These flies were very actively running and confined to an area of about 10-12 cm diameter at a

height of about 3 m. Although no copulations were observed, one-on-one interactions were frequent. Clusters of mixed gender may be more common at greater heights than generally accessible to an observer. At lower heights, mostly individual females are observed, which are possibly already mated and are searching for oviposition sites.

In the laboratory, captive flies in Petri plates of both genders were seen to bob and vibrate the abdomen in a vertical plane. This was usually associated with forward wing movements but more generally with agitation or excitement when orienting to each other. Males also occasionally arch the abdomen upward which is likely required to remove the elongate aedeagus from the genital pouch as suggested by Shatalkin (1993).

### Mating behaviour

Observations supported by photographs were made on copulating pairs of *S. angustipennis* in Petri plates. The male uses the hind trochanters and bases of the hind femora to squeeze the female ovipositor laterally at the base of the oviscape (segment 7). The male hind tibiae are tightly appressed to each other and flexed against the hind femora which brings the apices of the tibiae up against the posteroventral surface of the female sternite 6. The apices of the mid tibiae may rest dorsolaterally on the female abdomen in the vicinity of segment 4 with the mid tarsi dangling down from the sides of her abdomen. The front tibiae reach over the wing base of the female and the tarsi drape over the scutal / pleural area toward the postpronota or the front coxae of the female. The male sternites may flex along the medial concave weakening to assist in stabilizing the female abdomen in a medial position. This surface is tightly appressed to the female ovipositor as the female abdomen is flexed upward at nearly 90° between segments 6-7.

Though only seen once fleetingly under magnification, the posture of *S. pengellyi* is very similar except the curvature of the mid basitarsus allows it to wrap more conformingly to the contour of the female abdomen and only the apical four segments of the tarsus dangle down. No functional explanation for the modifications of the male front tarsus was noted. Males were never observed to use their legs in any obvious courtship display. The male of *S. pengellyi* was also seen to bring the wings forward at about a 45° angle anteroventrally toward the female's head (Fig. 21) on each of two occasions when copulatory attempts were observed. This may allow the female to see the black spot on the wing of the male as has been suggested recently for a dolichopodid with a similar behaviour (Satô 2006). Such ornamentation of the wing, or "badge" sensu Zimmer et al. (2003), is common in the Diptera but the location in *S. pengellyi* is at least unusual if not unique. During the many prolonged copulations observed of *S. angustipennis*, the male flexed the wings to such a position less frequently and only briefly.

Internally, as observed in one cleared preparation of an *in copula* pair of *S. angustipennis*, the acrophallus reaches the anteroventral vaginal sclerite of the female, the tips of the "hooks" reaching the level of the ventral receptacle. Though located within segment 6 in this preparation, these structures of the female would likely have to be located, at least temporarily, within the oviscape (segment 7) before the male squeezes the oviscape with its hind legs.

## Acknowledgements

Some institutions not listed here confirmed that their holdings did not include specimens of *S. pengellyi*. Helpful comments on previous drafts were given by M. Buck, S. A. Marshall, (DEBU), and J. H. Skevington (CNCI). Ontario Parks, Research and Planning Section, (W. J. Crins, contact), included me on the collection permit issued to S. A. Marshall for provincially administered and protected areas. S. B. Holmes (GLFC) provided access to some of the collection data for *Strongylophthalmyia* species. M. Francis and L. Rowlinson (Ontario Ministry of Natural Resources, Sault Ste. Marie) set out traps in northern locations. M. T. Dumas (GLFC) identified the fungi on aspen and C. N. Davis (GLFC) took scanning electron micrographs. Domtar Inc., and Ontario Living Legacy Trust provided financial and in-kind resources for the establishment of the White River site (through S. B. Holmes). The Canadian Forest Service, GLFC, provided field support and laboratory space. S. A. Marshall provided use of microscopic drawing facilities.

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